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12 October 1961

MEMORANDUM FOR: Beacon Testing Panel

SUBJECT: TSD/Audio Operations Branch Test Evaluation Report

1. Continued tests of the HRT-2 engineering prototype were conducted on 3, 4, and 5 October 1961 [redacted]. Attending as representatives of TSD/AOB were [redacted] represented DPD, [redacted] TSD/SB, and [redacted] Communications Division.

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2. This test was a continuation of tests held on 14 and 15 September in order to determine:

a. Whether improvements in range gained by modification of the aircraft antenna system were of a magnitude to justify initiation of a large scale modification program in the field.

b. To compare ranges obtained with the standard ANA/42 antenna with those gained with a quarter-wave, balloon-supported wire.

3. Comparative Test Results of Beacon Antennas and Aircraft Antennas:

a. (1) After the tests of 14 and 15 September, the aircraft returned to Bolling Field where Messrs. [redacted] interviewed electronic maintenance technicians in order to more fully understand the performance criteria of the airborne direction-finding equipment. During the interview it became apparent that, as a result of an Air Force modification involving the DF SENSE antenna, there was a possibility that system performance had been degraded.

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(2) This modification involved the exchange of the original long-wire SENSE antenna on the undercarriage of the aircraft for a short stub-type BLADE antenna. Comments by the Air Force technicians indicated that this modification had been performed because normal Air Force beacons transmit sufficient power (of the order of magnitude of one kilowatt) so that the sensitivity provided by the more elaborate long-wire was unnecessary.

SECRET

SECRET

(3) In order to obtain maximum range from the beacon, it was felt that tests with both aircraft antennas should be made simultaneously with a receiver of known performance. In order that this be accomplished, Air Force C-47 No. 75 was modified to include not only the BLADE antenna, but the long-wire SENSE antenna in its original location. Wires from both antennas were made easily accessible for rapid interchange in the air. The ARN-7 airborne ADF equipment was removed from the aircraft and aligned in the presence of [] to insure maximum performance. The result of the airborne test [] using both the BLADE and long-wire SENSE antennas, can be readily observed from the data contained in the attached sheets. In general, however, it may be said that a 20% increase in range was obtained when using the original long-wire SENSE antenna instead of the BLADE. For this reason, and the simplicity of the re-modification, it is the recommendation of the Audio Operations Branch that this modification be incorporated into all operational aircraft now using BLADE antennas.

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b. Results of Balloon Antenna Test:

(1) The testing of the balloon originated as an AOB requirement in support of pending field operations, however, it was decided that if the shaped balloon appeared operationally feasible during the test, it would, when used with the HRT-2, prove a valuable addition to the "family" of antennas for this system. In the period before the HRT-2 becomes available in production quantities, the balloon would necessarily be used in conjunction with the RTA-3 (part of the BN-2), the currently available beacon system. In the test, it was found that the HRT-2 would not properly load the quarter-wave balloon-supported wire. The RTA-3, however, loaded the antenna sufficiently to provide stable azimuth indications at ranges in excess of 40 miles. Although the HRT-2 would not properly load this antenna, it provided signals which gave a stable azimuth indication at distances of 25 miles.

(2) Because of the inherent problems of re-supply involved, the quarter-wave, balloon-supported wire, despite its obvious range advantages, it is not recommended as a general purpose solution to the beacon antenna problem. This decision ultimately rests with the field personnel who must finally decide whether the increased range provided by such balloon systems justifies the difficulties of gas re-supply.


4. AOB has initiated a twofold program which will provide the field with an immediate balloon capability and will ultimately result in a more elaborate package of optimum design which can be used not only with the RTA-3, but with the HRT-2 [] Beacon Transmitter, of primary concern here.

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5. It is our recommendation that action be taken to modify the HRT-2 output circuit so that it will properly match this antenna. It should be understood that the quarter-wave vertical antenna is the best antenna system obtainable in this frequency range. Ranges obtained with any company, general purpose, collapsible device, such as the ANA/42, can only approach, but will never exceed, those gained by the full-sized quarter-wave system.


TSD/AQB/Technical Support Section

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MEMORANDUM FOR THE RECORD

SUBJECT : Results of HMF-2 Beacon Tests Conducted 4-5 October 1961

1. General The second series of air to ground homing tests were conducted on 4-5 October 1961. The purpose of these tests is to determine the operational acceptability of the HMF-2 transmitter utilizing either the ANA-42 or the ~~for~~ 150 foot balloon antenna. The C-47 used in the tests was equipped with an ARN-7 radio compass. The antenna system on the ARN-7 was modified so that the aircraft could select the blade antenna or the long wire antenna to compare the range and reliability of each. Weather in the test area was excellent during all tests. Ground conductivity in the test area is 2 millimho, one of the lowest in the United States, a factor that must be considered when evaluating the test results. Personnel conducting this series of tests were:

[redacted] TMO
[redacted] TMO
[redacted] TMO
[redacted] TMO

The test results are attached.

2. Observations Both day and night tests were conducted. General observations made during the tests that should be noted are:

a. Utilizing the balloon antenna on the transmitter increased audio reception range from two to six times as compared with the ANA-42 antenna.

b. Utilizing the fixed wire antenna on the aircraft as opposed to the blade antenna approximately doubled audio range. (NOTE: Audio range is most important because a pilot tunes for this signal. A radio compass needle indication was received at much greater ranges than the audible signal. These longer ranges are not considered significant because in an operational environment the audio would be used for initial tuning.)

c. Below 1500 feet, 4 to 5 seconds is required for station passage. The first indication of station passage is when the aircraft is directly over the transmitter site. Station passage required 7 seconds at 6000 feet.

S-E-C-R-E-T

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- d. Night operation reduced audio range approximately 50%.
- e. A radio compass needle indication is received on the ARN-7 long before a signal is audible. (See note in paragraph 2b above)
- f. In the flat terrain of the testing site, reception range was approximately the same in all quadrants flown.
- g. 10-15 knot winds prevailed during most of the testing. This did not affect balloon operation, antenna effectiveness or receiver range. A newly developed shaped balloon was used.

3. Conclusions Radio reception range is greatly increased using the balloon antenna compared with the ANA-42, therefore development and procurement should be directed toward this antenna system. Because of the security aspects of a balloon system and its limitations (not useable in trees and high winds) a backup system should be made available. Radio reception ranges using the ANA-42 are not acceptable for operational use so it can be eliminated from consideration as a backup in its present design.

4. Recommendations The following recommendations are submitted to the panel for consideration:

- a. Recommend the HF Beacon (HBT-2) program proceed as follows:
 - (1) Conduct HBT-2/balloon antenna tests in mountainous terrain to determine range and reliability factors.
 - (2) Field test this combination overseas and obtain users evaluations.
 - (3) If field tests are satisfactory, procure and stock this combination for Agency use. Concurrently modify all aircraft so that the long wire antenna can be used (This is a minor modification. The aircraft antenna system can be returned to the original configuration in two man hours.)
- b. Since the HBT-2/ANA-42 combination does not provide acceptable audio and azimuth ranges and a backup beacon is required, recommend the following action be taken to provide a backup antenna:

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S-E-C-R-E-T

(1) Modify the ANA-42 to that satisfactory audio and azimuth ranges are obtained. If this is not practical:

(2) Develop a new antenna that will provide acceptable ranges.

c. Recommend that a preamplifier be procured and installed on the ANA-6 and 7 to determine what increase in range is experienced. Procure this item for installation if the tests results so dictate.

Major

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Distribution:

- 2 - EB/OPSER
- 2 - TSD/AOB
- 1 - AC/DPD
- 6 - 1 each member
Tech Reg. Panel
- 1 - HB/DPD
- 1 - MB/DPD
- 1 - COMMO/DPD
- 2 - ASB/DPD

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A	B	C	D	E	F	G	H	I
HEADING	INBOUND OR OUTBOUND TO	ALTITUDE	SIGNAL 1ST AUDIBLE (NM)	NEEDLE INDICATION 1ST RECEIVED (NM)	AZIMUTH ACCURACY	1ST STABLE NEEDLE (NM) (5° SPREAD)	TIME FOR STATION PASSAGE (IN SEC)	REMARKS
4 Oct. (Day)								
Aircraft Antenna: Fixed Wire			Transmitter Antenna: ANA/42					
355	Out	500	9	12	15°	11	4	
175	In	500	5	13	5°	13	4	
355	Out	1,000	9	13	20°	12		
175	In	1,000	7	19	30°	13		
355	Out	500	8	15	30°	10		
175	In	500	7	15	25°	8	5	
065	Out	500	8	16	30°	13		
245	In	500	7	12	20°	11	4	
Aircraft Antenna: Blade			Transmitter Antenna: ANA/42					
355	Out	500	8	9	30°	8		
175	In	500	4	14	30°	7	5	
065	Out	1,000	7	9	30°	8		Signal Available on Loop to 9 Mi.
245	In	1,000	4	15	30°	7	5	
Aircraft Antenna: Blade Fixed Wire			Transmitter Antenna: Balloon RT-3 Transmitter					
355	Out	1,000	50	44	30°	38		
175	In	500	50	50	20°	45		
Aircraft Antenna: Fixed Wire			Transmitter Antenna: Balloon HRT-2					
355	Out	500	20	50	25°	34	4	
175	In	500	22	31	20°	25	4	
Aircraft Antenna: Fixed Wire			Transmitter Antenna: ANA/42					
065	Out	1,000	8	20	20°	12	4	
245	In	1,000	9	12	20°	10		
355	Out	10,000	22	48	30°	25		
175	In	10,000	22	23	20°	20	7 Sec. at 6,000 Ft.	

* Note: Ref D, E, and G above: On outbound legs record when signal last audible, indication last received, and needle stability lost.

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4 Oct.
(Nite)

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